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Process Inventory Management in a Production Company

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Abstract

This paper analyses the economics of material management in the 7up Bottling Company, Benin for the duration (2011 – 2015) with a view of designing a process inventory. The specific objectives were to determine the level of efficiency and product improvement in material management, investigate whether the material management practice permit high stock turnover validation and to proffer useful suggestions on how to effectively manage the company materials. The variance analysis and Economic Order Quantity (EOQ) model were used to analyse the data collected. The results showed that the company spent a total of 118.8 million naira for production process and made a total sale of 395.84 million naira. This implies that the company optimises production by adopting the EOQ model into their production process and management. Based on these findings, the study recommends that optimal quantity and timing of material ordering in production process is a key to profit maximisation.

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Keywords

Economic Order Quantity (EOQ) model;

Manufacturing Industries;

Material Management;

Process Inventory Management;

Variance Analysis.

1. Introduction

Inventories has been described as the life wire of any manufacturing organisation, it represent investment designed to assist in production activities and/or serve customers without any doubt, inadequate supply of inventories may grind manufacturing operations into a halt (Aashna & Vivek, 2016; Unyimadu, 2014). The importance of material to efficient operation of a manufacturing organisation cannot be over emphasised; in that the availability of the material in the right quality and quantity will determine to a reasonable extent; the availability, quality and quantity of the resultant output. Material management is critical to the overall performance of a manufacturing concern. Beside demand and other forces like competitor's actions and general price index; raw material situation in terms of efficient management and effective planning determines the activity level, the turn-over and the ultimate profit in a given company. The determination of economic order quantity (EOQ), re-order level and minimum/maximum stock levels is important in material management in any manufacturing outfit. The material function is assumed to be organised and operated on an integrated basis and is also presumed to be responsible for material forecasting, planning, inventory control, scrap control and disposal; providing management information regarding purchases and inventories within the framework of the financial policies and norms. A glance at these functions will reveal the intricacies involved in maintaining balanced policies on material management.

Material management being the coordination of efforts (planning, controlling, organising, directing) towards achieving efficiency in the procurement, transportation, stocking and utilisation of inputs of a manufacturing organisation is therefore central to production activities and management. Effective and efficient functioning of the material management has direct bearing on the total performance of the organisation. The management of raw material in a manufacturing organisation therefore deserves attention and critical study in order to achieve uninterrupted production runs and enhanced performance in operations (Khalid, 2008). Besides, holding the right stock level could improve the level of available working capital that could be profitably employed in other areas. These objectives could only be achieved through integrated approach to material management functions by combining planning, procurement and inventory control.

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The process of control and management of material is a very important factor in the success or failure of any business for example; little stock will result in stock out which will disrupt the production distribution cycle that is crucial to the survival of all manufacturing companies while too much stock will tie down the resources of a company. Poor or inadequate material management can present a serious challenge to the productive capacity of a manufacturing organisation. In addition to raw materials and finished goods, many companies also maintain items of assets, property, inventories of work in progress, office supplies, business firms and general operation supplies.

Materials often constitute the most significant part of current assets of large companies. In the public limited companies, materials, especially raw materials are approximately 60% of current assets on the average. The US Bureau of census stated that inventory and accounts receivable are the two largest accounts of equal magnitude and together they comprise almost 80% of current assets and over 30% of total assets for all manufacturing companies. Considering the large sum of money that is committed to the stocks of raw materials, work in progress and finished goods, it is therefore of paramount necessity that these stocks be managed efficiently and effectively in order to avoid the jeopardising of the profit position of the firm. In material management, there is an optimum level therefore inadequate inventory causes loss of sale and disrupts the production process while excessive stock level leads to unnecessary carrying cost and obsolescence or spoilage risks. According to Homgren (2007), the optimum inventory level lies between the inadequate inventories and the excessive inventories. Materials management aims at maintaining an optimum inventory level that will be carried at the least cost.

1.1 Concept of Materials Management

Materials management is a tool to optimise performance in meeting customer service requirements at the same time adding to profitability by minimising costs and making the best use of available resources. The basic objective of materials management as explained by Banjoko (2000) and Jacobs *et al.* (2009) is to ensure that the right item is bought and made available to the manufacturing operations at the right time, at the right place and at the lowest possible cost. According to Wild (1995), materials management is a concept, which brings together the responsibility for determining the manufacturing requirement that is scheduling the manufacturing processes and procuring, storing and dispensing materials (Ondiek, 2009; Wild, 1995).

An integrated approach to material management defines it as the function responsible for the coordination of planning, sourcing, purchasing, moving, storing and controlling materials in an optimum manner so as to provide a predetermined service to the customer at a minimum cost. Ramakrishna (2005) and Gopalakrishna & Sundaresan (2006) gave definitions that provide the scope of materials management, which includes materials requirements planning (MRP), decision on purchasing, procurement of materials, inventory management, staffing, stores and warehouse management, production and distribution of finished goods at minimum cost at due time (Monday, 2008; Ogbadu, 2009; Osotimehin, 2006).

Chase *et al.* (2009) explained the concept of materials management brings in the total systems approach to managing the entire flow of information, materials and services from raw materials suppliers through factories and warehouses to the end user/customer. The study further confirmed that a firm's success depends on how they manage their materials effectively. This indicates that it is important to monitor inventory at each stage because it tics up resources. Therefore, effective materials management is fundamental to the survival of business, industry and economy.

1.2 Concept of Inventory

Inventories are vital to the successful functioning of manufacturing and retailing organisations. This is because many companies hold inventories as part of their business operation. Inventories make up the most significant part of current assets of most companies especially the manufacturing companies. The need for management to ensure inventory control if properly managed cannot be over emphasised. A firm neglecting inventory management will be jeopardising its ling run profitability and it may end up failing in its business. The definition of inventory has been defined by many professional bodies and scholars in different ways. The Microsoft Encarta premium defined it as the quantity of goods and materials on hand. A manufacturer's inventory represents those items that are ready and available for sale.

According to Jain *et al.* (2010), inventory is the aggregate of these items of intangible property which are held for sale in the ordinary cause of the business, held in the process of production for such sales to be currently consumed in the production of goods and services to be made available for sale.

However, according to Ama (2009), inventory is the stock of goods a firm is producing for sale and the components that make up the goods. A key decision in manufacturing and retail is how much inventory

to keep on hand. Once an inventory level is established, it becomes an important input to the budgeting system.

1.3 Techniques of Inventory

The following are techniques that are used for the calculation of inventory so that we can have a control over inventory (Sharma & Arya, 2016):

(a) *Economic Order Quantity (EOQ)*: This is the ideal order quantity a company should purchase for its inventory given a set cost of production, demand rate and other variables. This is done to minimise variable inventory costs, and the equation for EOQ takes into account storage, ordering costs and shortage cost.

(b) *Safety Stock*: This is an additional quantity of an item held in inventory in order to reduce the risk that the item will be out of stock, safety stock acts as a buffer in case the sales of an item are greater than planned and /or the supplier is unable to deliver additional units at the expected time.

This paper studied the economics of material management in the 7Up Bottling Company, Benin and it determine the level of efficiency and product improvement in material management and investigates whether the material management practice permit high stock turnover validation and to proffer useful suggestions and ideas on how to effectively manage materials.

2 Research Methodology

The study was conducted in 7Up bottling Company, Benin, Edo State. The choice of the branch in Edo State was guided by the fact that it is one of the active production plants of the company. Five staff from the quality control department were specifically chosen to ensure that data collected were accurate, relevant and dependable thereby making this study more effective and its result reliable. The raw materials that serve as input being used by the company for the manufacturing of its assorted produces can be classified into core raw materials and packaging materials.

Core raw materials are sugar, acciducant, concentrate and hydrated lime while the packaging materials in Carton/Crate include Seven Up, Mirinda Orange, Mirinda, Pepsi, and Mountain Dew (all 24 bottles in a crate). The study adopted procedures for the determination of optimal order size, optimal number of orders, optimal time between orders and optimal number of unit per production run. The cost of raw materials using economic order quantity and the cost saving effect was examined using EOQ model as follows:

$$EOQ=\sqrt{2c_oD/C_c} \quad (1)$$

Where, C_o is the ordering cost, C_c is the carrying cost and D is the annual demand.

3 Results and Discussion

Figures 1 and 2 compare the budgeted and actual sales of 7Up Bottling Company. As observed (Figure 1), the company witnessed a surplus for the five years understudy, because there was a positive variation in each of the years. Positive variation indicates efficiency on the part of the company while negative variation indicates inefficiency since the basic objective of any profit-making company is to maximise sales.

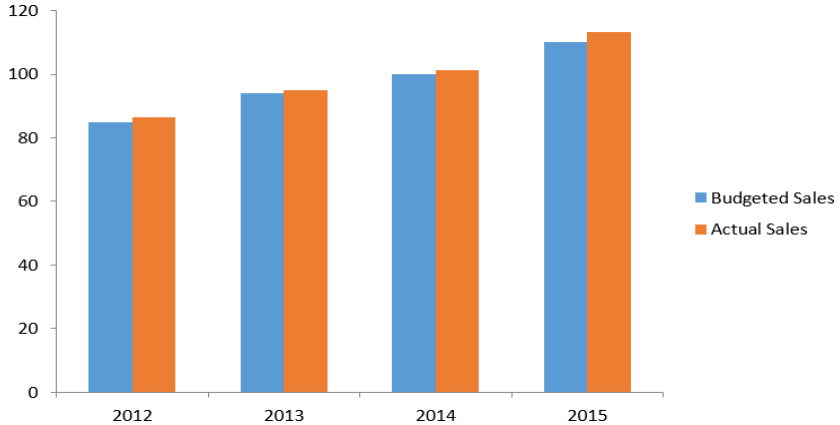

Figure 1. Comparison of budgeted and actual sales (in millions of Naira)

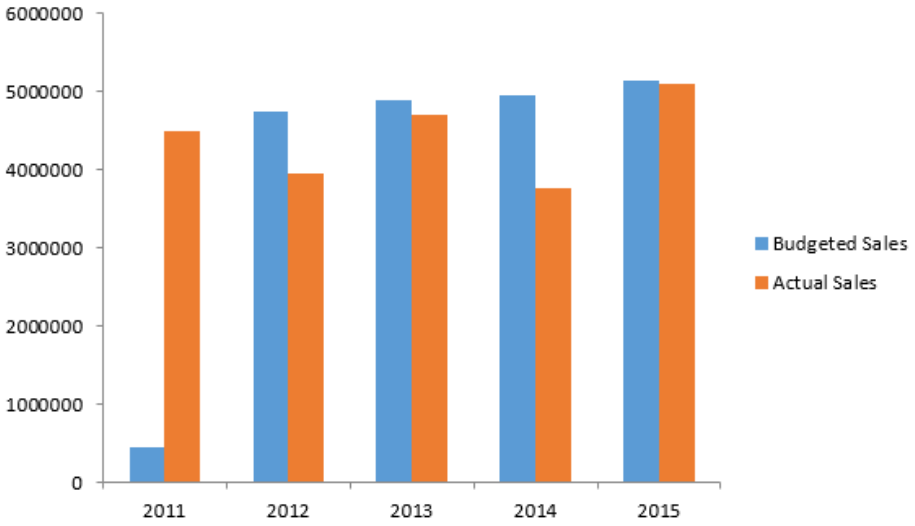

Figure 2. Sales in Crates (Volume of Production)

From Figure 2, the variance reflects the inability of the company to meet its target for a period of four year (2011-2015) out of the five years understudy. Upon interview, it was explained that this had no negative impact on the overall profit, as it is part of the company's policy to plan in excess of forecast so that even when actual production does not equal budget, it is of no negative consequence. Table 1 shows the annual demand, ordering costs, carrying costs of raw and packaging material of 7up for the duration (2011-2015).

Table 1. Annual Demand, Ordering Costs, Carrying Costs of Raw and packaging Material of 7Up (2011-2015)

Years	Annual Demand	No. of Orders	Materials Units Cost (₦)	Ordering cost of Order (₦)	Carrying cost as a % of Unit (₦)
Sugar					
2011	840,000	3	320,000	7,000	4,000
2012	900,000	3	360,000	8,000	4,000
2013	950,000	3	410,000	9,000	5,000
2014	1,010,000	3	480,000	11,000	6,000
2015	1,070,000	3	520,000	12,000	6,000
Concentrate					
2011	450,000	3	210,000	8,000	3,000
2012	600,000	3	220,000	10,000	3,000
2013	700,000	3	230,000	12,000	4,000
2014	720,000	3	240,000	13,000	4,000
2015	800,000	3	250,000	20,000	5,000
Acciducant					
2011	650,000	3	240,000	9,000	3,000
2012	840,000	3	300,000	10,000	3,000
2013	900,000	3	330,000	11,000	3,000
2014	950,000	3	350,000	13,000	3,000
2015	1,000,000	3	400,000	14,000	3,000
Hydrated Line					
2011	650,000	3	240,000	9,000	3,000
2012	840,000	3	300,000	10,000	3,000
2013	900,000	3	330,000	11,000	3,000
2014	950,000	3	350,000	13,000	3,000
2015	1,000,000	3	400,000	14,000	3,000
Packaging Materials					
2011	650,000	3	240,000	9,000	3,000
2012	840,000	3	300,000	10,000	3,000
2013	900,000	3	330,000	11,000	3,000
2014	950,000	3	350,000	13,000	3,000
2015	1,100,000	3	400,000	14,000	3,000

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From Table 1, the inventory purchased for production process for the period (2011 -2015), indicates that the company had a total sugar demand of 4,770,000 in 15 numbers of orders at a total unit cost of ₦2,090,000, which cost the company ₦25,000 for carrying these materials. For concentrate, the company made an overall total demand of 3,270,000 in 15 numbers of orders at a total ordering cost of ₦63,000 for ₦1,150,000 unit cost. For acciducant, it cost the company ₦15,000 to carry acciducant material units with a cost of ₦1,620,000 after making a total demand of 4,340,000 in 15 numbers of orders within the specified period of 2011-2015. Hydrated lime, which is another very important inventory for 7up bottling company, in the processing of their product, cost the company ₦15,000 for carrying a total unit of ₦1,570,000 after making a total demand of 4,340,000 in 15 numbers of ordered from 2011 to 2015. Packaging materials used for the production of bottles and corks were ordered in 15 numbers of ordering within 2011 and 2015 and it cost the company ₦15,000 to carry a total unit worth of ₦1,720,000 after demanding 4,690,000. Table 2 shows the ordering time between materials while Table 3 shows the EOQ and total material cost.

Table 2. Ordering Time between materials (in days)

Materials	Ordering Time in Days					Total	Average
	2011	2012	2013	2014	2015		
Sugar	250	300	317	337	356	1570	314
Concentrate	150	200	233	240	267	1090	2118
Acciducant	217	280	300	317	333	1447	289
Hydrated Lime	280	300	317	337	280	1514	303
Packaging Materials	267	280	320	350	367	1584	317

Table 3. EOQ and Total Material Cost (2011-2015)

Years	Optimum Order of Quantity (Q) Units	Total material Cost (₦ Million)
Sugar		
2011	3031.08	2,133,891.72
2012	10000	722,180
2013	9133.16	1,872,298.05
2014	2777.6	4,399,830.39
2015	9072.56	2,830,575.9
Average		2,391,755.212
Concentrate		
2011	33806.6	1,171,395.98
2012	13483.9	889,943.8
2013	13513.2	1,243,221.62
2014	13964.2	7,373,147.60
2015	16000	11,000,000
Average	18153.6	4,335,541.68
Acciducant		
2011	12747.54	917,823.51
2012	13662.60	1,229,634.05
2013	4045.19	2,647,587.95
2014	48500.135	2,800,955.32
2015	4830.45	3,188,107.6
Average	8027.18	2,156,821.69
Hydrated Lime		
2011	34156.50	132,597.42
2012	11925.69	590,321.77
2013	46904.15	743,892.48
2014	4994.94	2,734,736.52
2015	1527.52	1,008,169.40
Average	1285943.5	1,041,943.52
Packaging Materials		
2011	13601.47	648,459.28
2012	4320.49	2,138,645.96
2013	14605.93	1,445,987.55
2014	16124.51	1,693,074.13
2015	16020.8	1,922,478.37
Average	9730.48	1,569,729.06

From Table 2, the company in 2011 at every 250 days, orders were placed for unit quantity of sugar, while in 2012 the company placed orders for sugar at every 300 days interval to replenish stock. In 2013 orders for unit quantity of sugar were made at every 317 days and in 2014 stock were replenish for 337 days interval. In 2015, the company placed orders for unit quantity of sugar for 356 days, meaning only once a year. Generally, the ordering time for sugar averaged 314 days within 2011 to 2015. For concentrate another important raw material for the processing of their product, it can be clearly seen that in 2011, the company order for 150 days intervals and in 2012 orders were made at every 200 days intervals. In 2013 orders were made at 233 days interval and in 2014 orders were made at every 240 days intervals. In 2015, the company order unit quantity of concentrate at every 267 days in a year. This implies that the time of ordering average 218 days within 2011 to 2015. For acciducant and hydrated lime, the ordering time averaged 289 days and 303 days within 2011 to 2015. For packaging materials, the average ordering time is 317 days. The ordering time gives an indication of how inventory is managed to minimised cost and maximised production in 7up bottling company.

From Tables 3, it is seen that from 2011 to 2015 the company witnessed increase in the cost of materials for the five years under study. This actually exceeded the budgeted cost for materials. Although this could be attributed to the increase in the prices of raw materials, incessant increase in fuel price, technology and labour and the resulting effect of inflation in the Nigeria Economy. This went a long way to affect company's profit negatively during those periods of sky-rocketing inflation level. Table 4 shows the optimum ordering quantity, ordering time and overall production cost

Table 4. Optimum ordering quantity, Ordering Time and Overall production cost

Raw Materials	**Optimal Ordering Quantity Units**		**Optimal Ordering Time (Days)**		**Total Cost** ₦	
	Total Ordering Quantity	*Average Ordering Quantity*	*Total Ordering Time (days)*	*Average Ordering Time (days)*	*Total Cost*	*Average Cost*
Sugar	24,941.84	4,988.37	1,570	314	1,195,776.06	239,155.212
Concentrate	90,768.1	18,153.62	1,090	218	21,677,708.44	4,335,541.688
Acciducants	40,135.9	8,027.18	1,447	289	10,784,108.48	2,156,821.696
Hydrated Lime	99,508.8	19,901.76	1,514	303	6,429,717.926	1,285,943.585
Packaging materials	48,652.4	9,730.48	1,584	317	78,685,665.29	15,737,133.058
Total					118,772,976.196	

The results (Table 4) shows that the company ordered an average of 4,988.37 unit of sugar at an average ordering time of 314 days and at an average minimal cost of ₦239,155 from 2011 to 2015. For concentrate used for the production of the company finished product such as 7up, Pepsi, etc. The company ordered an average quantity of 11,853.62 units at an average cost of ₦4.3million for an average number of 218 days within 2011 to 2015. For acciducant and hydrated lime the company ordered 8027.18 and 19,901.76 units respectively at optimal time of 289 days and 303days respectively within 2011 to 2015. The average cost of packaging materials, cost the company ₦15.7million for an average quantity of 9730.48 unit, which they ordered at an average number of 317 days. A comparison between the overall total cost of production and total sales for the period under review shows that the company spent a total amount of ₦118.8 million and made a total sales of ₦395.84 million within 2011 to 2015. Therefore the efficient and effective management of materials was responsible for the company's huge profit of ₦277.04 million.

4. Conclusion

Finding out the profitability, efficiency and effectiveness in the management of raw material in 7 up bottling company with the view to optimise quantity so as to minimise the cost of production, the following findings and observations were noted. The study showed that the company operates a policy of making orders on a quarterly basis within a period of one year. Analysis of data showed that the company does not always adopt the EOQ model in placing orders for its raw materials and this account for the variations between the calculated EOQ and the expected order sizes of the company. For at least three years out of the five years under study, the expected value was greater than the observed value for each product. This implies that 7Up Bottling Company, Benin Plant has excess investment in inventory.

Analysis of data further revealed that there is a positive correlation between sales and inventory usages. However, the total cost of production of 118.8million naira can be observed to be less than the total ₦395.84 million. This implies that with proper material management using the EOQ model the company

could optimise and as well maximise its profit potentials. Again material usage depends on sales that means as sales increases, inventory usages should also be on the increase. Therefore, material management is a must for the continuity and survival of any goal focused manufacturing organisation.

Conflict of Interests

The author declares that there is no conflict of interests associated with this research.

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